

RESEARCH REVIEW TEAM DATA REQUEST

Office of Hydrology (OHD) - Hydrology Laboratory Response

- 1.) Please provide a copy of the most recent evaluation of the lab or center in pdf format. Was this review internal or external?**

An external was organized in 1998: A copy of the final report is attached (DormanReport.pdf).

- 2.) Please provide a brief history, and mission of your laboratory /center.**

History

The Hydrology Laboratory provides directed research and development in support of the National Weather Service (NWS) hydrologic program. The NWS hydrologic program began with the early development of Federal weather services. Joint Congressional Resolution H.R. 143 of February 2, 1870 established a Weather Service and assigned it to the Signal Service of the War Department. By 1873 this service had been called upon to correlate weather and river and stream conditions. Daily river state readings were being obtained and published and collection of river and flood data had begun.

The Congressional Organic Act of October 1, 1890 assigned to the Weather Bureau the duties of '...the forecasting of weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce, and navigation, the gauging and reporting of rivers...'. In July 1891, the Weather service was transferred to the Department of Agriculture and the Weather Bureau was established.

In September 1893, a system of 16 river districts was established and river and flood forecasting responsibility was delegated to local station officials. In 1894 this system was increased to 21 river districts. Expansion of the river and flood services continued through the turn of the century. By 1911 there were 601 paid and cooperative stations reporting to a total of 56 river districts. River forecasters were receiving daily reports of river stages and changes during the previous 24 hours and forecasting river levels for periods of up to seven days on the basis of empirical rules and personal knowledge of the river basin. Daily river bulletins were issued by most large stations and included a copy of the weather map and tables of temperature, wind and precipitation data.

In the mid 1930s a vast expansion took place and the river and flood service progressed rapidly toward implementation of important new forecasting techniques. In 1937 the Hydrometeorological Research Section was established and the subdivision of the United States into hydrologic regions was initiated for the purpose of procedure development and analysis of rainfall-runoff relationships. Reorganization Plan Number IV of June 30, 1940 transferred the Weather Bureau from the Department of Agriculture to the Department of Commerce. The continued responsibility of the Bureau to provide hydrologic services was further emphasized by 15 U.S.C. 313

By 1940 the collection of basic data and preparation of forecasts and warnings was being carried out through 73 river district offices and procedures for making forecasts were gradually being refined and extended through the 10 established hydrologic regions of the country.

By 1945 the Nation had been divided into 85 river districts each with a regular Weather Bureau Office designated as a River District Office. Each office was responsible for the entire river program within its district in addition to other meteorological responsibilities that included data acquisition, general public service and aviation service.

Development of the present service began in 1946 with the creation of River Forecast Centers in Cincinnati, OH and Kansas City, MO staffed with professional hydrologists to prepare river and flood forecast and refine hydrologic forecast procedures for specified areas. During this same period the river and flood service and the climate and crop weather service were consolidated into the Division of Climatological and Hydrologic Services. This consolidation was ended in September 1951 with the establishment of the Hydrologic Services Division and the Climatological Services Division.

During the following years further development and improvement of the hydrologic service occurred as additional River Forecast Centers were established and forecast procedures were improved. By Department of Commerce Order 91 (revised) effective April 15, 1964 the Hydrologic Services Division became the Office of Hydrology with the responsibility for the acquisition of hydrologic data; the preparation and dissemination of hydrologic forecasts and warnings; and the analysis and interpretation of hydrologic data. The continuing responsibility of the Weather Bureau to provide hydrologic services was reaffirmed during the consolidation in 1965 of environmental service functions of the Department of Commerce into the Environmental Science Services Administration (ESSA) and which became the National Oceanic and Atmospheric Administration in 1970.

The NWS Office of Hydrologic Development has provided precipitation frequency and probable maximum precipitation estimates for the U.S. for over 50 years. OHD PMP technology is the basis for WMO standards.

The field of water resources planning and management has developed rapidly and several Federal agencies have been assigned or created to handle specific responsibilities. Support to these agencies in the form of river forecasts and water management information is provided by the NWS Office of Hydrologic Development. Congress has designated that the NWS is the agency to issue official flood and river forecasts to the public and the NWS is assisted by many Federal, state, local and private organizations in the collection of river and rainfall reports and the dissemination of forecasts and warnings.

Mission

OHD Mission Statement: "Together, we develop and deliver valued science, software, and information for river and water resource forecasts to save lives and property, manage water resources, and enhance America's economy"

Specifically, the NWS Hydrology Laboratory (HL) enhances NWS products by:

- infusing new hydrologic science

- developing hydrologic techniques for operational use
- managing hydrologic development by NWS field offices
- providing advanced hydrologic products to meet needs identified by NWS customers
- developing and maintaining U.S. precipitation frequency standards, support users of the standards.
- providing real time operational data to NWS field offices from over 10,300 surface locations.

3.) Please provide a listing of major customers of the laboratory /center, with a one sentence description of what is being done for them.

NWS River Forecast Centers and Weather Forecast Offices: Hydrology Laboratory directed research provides OHD hydrologic forecasting techniques and tools which are the basis of NWS Hydrologic Services Program.

Federal, state, local regulatory agencies, U.S. civil engineering design and construction, U.S. environmental design, planning and stream based pollution control enterprises: Provision of precipitation frequency estimates.

Hydraulic engineers and hydrologists; Federal, state, local, and international government agencies; Engineering planners, designers, and analysts; Emergency managers, civil defense officials, and consulting engineers; Universities: Hydraulic routing which are used to determine the potential effects of a dam failure; possible future flood inundation mapping due to dam-break floods and/or reservoir spillway floods; forecasts which are used for water supply, navigation, irrigation, hydropower, reservoir flood control operations, recreation, and water quality interests.

Hydraulic modeling visualization tools which are used to show the extent of flooding in flood prone areas (flood mapping) and a visual representation of hydraulic phenomena.

4.) Please provide a summary of research being conducted (Your list of major requirements from the Program Baseline Assessments (PBA) maybe helpful in answering this question.)

4a. For each research theme identified above, include a brief explanation of how this research relates to NOAA program areas. (The program areas are those identified in the recent Program Baseline Assessment.)

4b. Provide the geographic scope of your research - regional, national, global.

4c Provide the time frames of your research - short term, (0-2 years), medium term, (2-5 years), long term (greater than 5 years).

1. Advanced distributed model for river and flash flood forecasting: (regional, 0-2 years)

Through in-house and collaborative efforts we are developing the NWS's first distributed hydrologic model. This model performed very well in the recent HL-sponsored international Distributed Model Intercomparison Project (DMIP). It is being tested as a prototype at four River Forecast Centers.

2. Advanced Frozen Ground Model: (regional, 0-2 years)

HL is developing an advanced, physically-based approach to modeling the effects of frozen ground on the rainfall/runoff process. This approach has been well tested in NCEP's numerical weather prediction model. Work is now 90% complete towards making this approach available as a NWS River Forecast Center hydrologic model.

3. Advanced Snow model: (regional, 0-2 years)

HL is beginning an effort to analyze new and emerging data sources for possible use to drive an operational advanced energy-budget snow model for river forecasting. Well-tested energy budget snow models are available, so the major question is the availability and quality of the data required to drive these models.

4. Variational Assimilation (regional, 0-2 years)

HL is prototype testing an advanced method of assimilating observed streamflow and precipitation data into its hydrologic models for river forecasting. The approach has shown success in HL testing and is now being field tested at one River Forecast Center

5. Parameter estimation and calibration: (regional, 0-2 years)

HL is heavily investigating the development of initial values of the hydrologic model parameters from existing and new data sources such as soils and geologic information. Significant effort is underway to develop a new automatic optimization schemes for hydrologic model parameters. Such new schemes will accelerate the process of model calibration at the NWS field offices.

6. Verification of RFC deterministic stage forecasts: (regional, 0-2 years)

OHD delivered the Interactive Verification Program to the RFCs in AWIPS Operational Build 1 (OB1). This software implements standard verification procedures as well as the new developments in the field of forecast verification using the joint distribution of forecasts and observations. Several tests of distribution distinctness are provided to permit the RFC forecasters to assess Reliability as well as Discrimination characteristics of their forecasts.

7. Short Term Ensemble Forecasts: (regional, 0-2 years)

The NWS has provided long range forecasts which explicitly account for the meteorological uncertainty in the forecasts for many years. We have recently provided to three of the NWS River Forecast Centers a process to do the same in the short term. This includes estimating the the uncertainty in the deterministic precipitation forecasts based upon the past performance of those forecasts, the re-formulation of this uncertainty into time which a river model can ingest, and then the procedures to compute the resulting uncertainty in the hydrologic forecast.

8. Hydrologic Model Uncertainty Estimates: (regional, 0-2 years)

One reason hydrologic model output is uncertain, is the model formulation and parameters cannot be known perfectly. Post processing the model output to account for model biases and then perturbing the model output to account for the uncertainty is one common method of addressing this sort of uncertainty. The OHD delivered a post-processing function to the RFCs in AWIPS Operational

Build 2 (OB2). The OHD delivered both a program to calibrate the post-processing function and the run-time function.

9. Probabilistic Verification: (regional, 0-2 years)

The OHD has been working with the Universities of Arizona and California Irvine to develop procedures for verifying probabilistic forecasts issued by the NWS RFCs. The universities have recommended procedures and now the OHD, in collaboration with the universities, the Riverside Technology, inc. and the Colorado Basin RFC is developing software to implement the procedures recommended by the universities.

10. Hydraulic river modeling: (regional, 0-2 years)

OHD has been (1) using Geographical Information System (GIS) visualization tools to improve dam failure forecast capabilities at RFCs for the protection of lives and property, (2) working with NOAA's Coastal Storms Initiative program to integrate river and coastal flooding results into a single product, and (3) accounting for river ice effects in the operational NWS hydraulic forecast model.

5.) Please provide a listing of 3-5 major accomplishments in the last five years.

1. Lead, organized, participated in the Hydrologic Distributed Modeling Intercomparison Project (DMIP) (12 groups, 4 international). This project has allowed NWS to determine "best of breed" distributed hydrologic modeling for use at NWS operational offices, and supported ongoing collaboration by documenting the activities and resulting research in a special issue of the Journal of Hydrology, due out Spring 2004.
2. Provided operational capabilities to produce flood forecast maps in flood prone areas including coastal areas.
3. Advanced snow and frozen ground approaches inserted into NCEP's numerical weather prediction model with documented improvements.
4. Development of national data set of initial parameters for NWS hydrologic model. Delivered to RFCs.
5. Publication of updates to semiarid southwest precipitation frequency estimates (2003)

6.) Please provide a summary of legal mandates for the work in the laboratory/center.

Joint Congressional Resolution H.R. 143 of February 2, 1870
Congressional Organic Act of October 1, 1890
Reorganization Plan Number IV of June 30, 1940 and 15 U.S.C. 313
Public Law 107-253, the Inland Flood Forecasting and Warning System Act of 2002
Susquehanna River Basin Compact, May 1972
NWS Policy and Directives, which established the objectives of the NWS Hydrologic Services Program
(<http://www.nws.noaa.gov/om/water/policy.shtml#10-1>)

7.) Attached in Excel format is the compilation of financial and staffing data that your

laboratory or line office provided. Please verify that data are correct.

The data are correct for the Laboratory, overall. However, the Laboratory consists of three Branches: the Hydrologic Science and Modeling Branch (HSMB), the Hydrologic Data Systems Branch (HSDB), and the Hydrologic Software Engineering Branch (HSEB). Only work in the HSMB is focused in the directed research area. This Branch consists of 9 FTEs, 17 contractors, and 5 students. The funding shown in the "Research Breakout MG3.xls", attached to an email sent out by David Green on 1/29/2004 is correct.

In your response please identify a contact person and a telephone number, in case clarifying information is needed.

Contact Person:

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